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Issues with condensable organics in European $PM_{2.5}$ emissions; key messages and follow-up from an expert workshop organised by EMEP MSC-W

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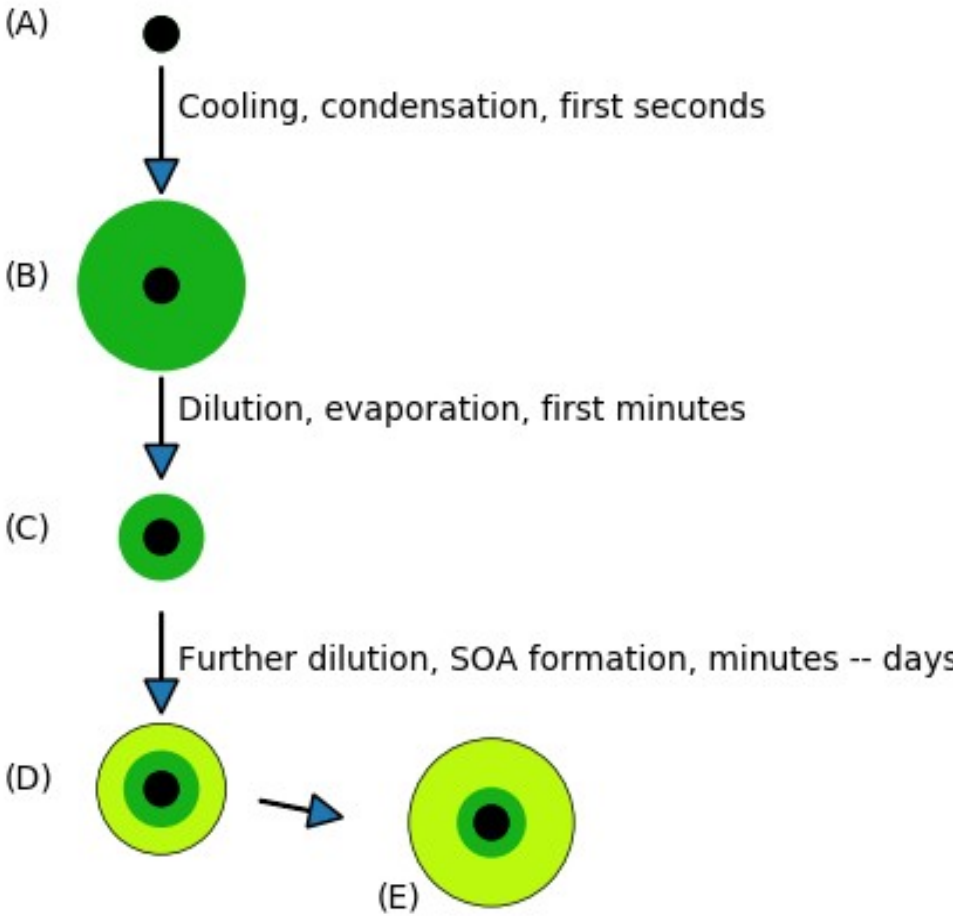
Primary organic aerosol (POA) emissions? Gas or particle?

- Condensables =~ semivolatile VOC
- Condensables may be missing from both PM and VOC inventories!
- Europe: Denier van der Gon et al., ACP, 2015, Simpson and Denier van der Gon, EMEP 2015, Ots et al., ACP, 2016, Jiang et al, 2019
- Basically, countries report apples and oranges!

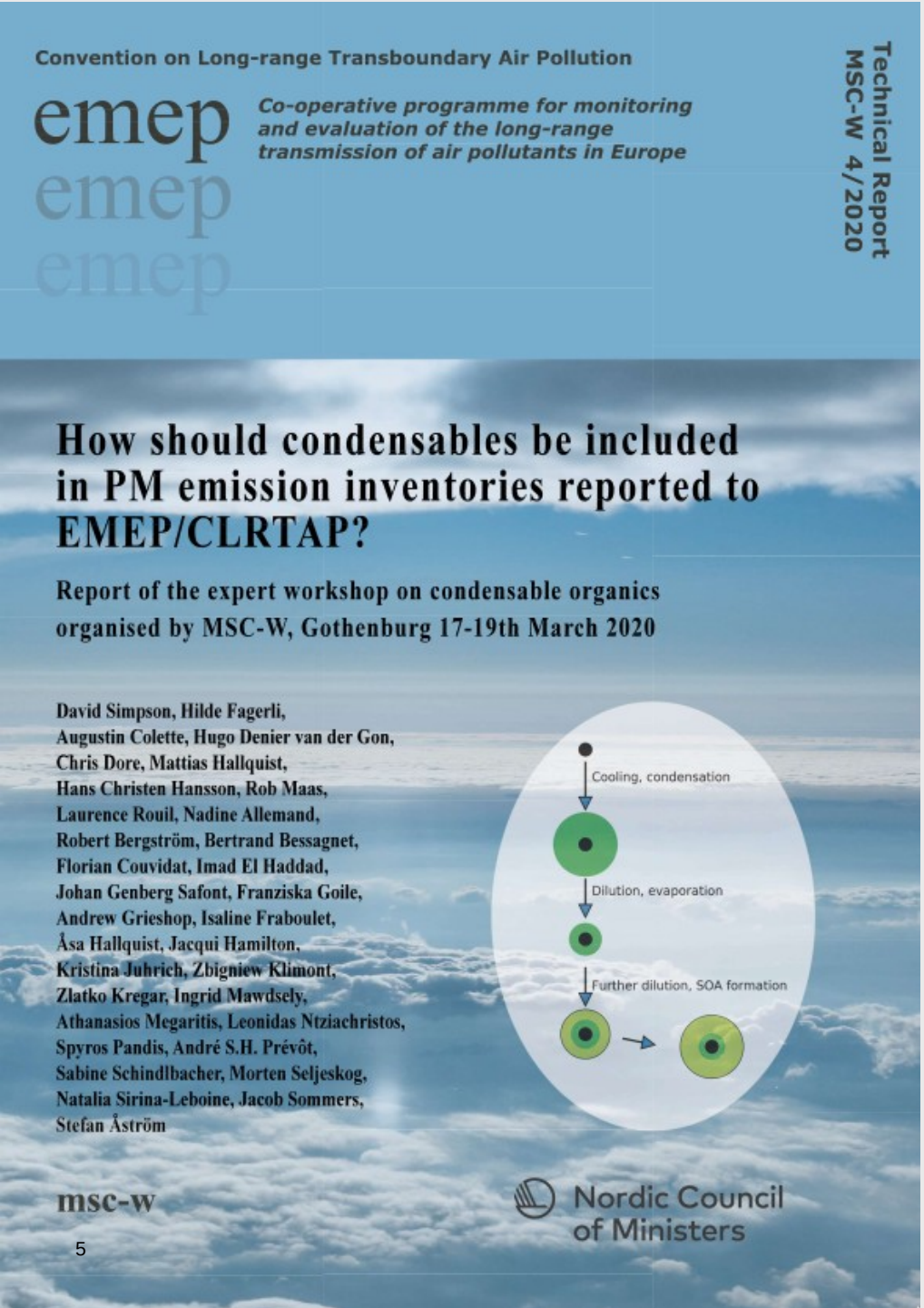


NMR-SVOC Workshop, March 2020

- Workshop to bring together experts in:
  - emission measurements,
  - atmospheric chemistry,
  - inventory experts, and
  - Modellers
- to systematically consider and recommend best approaches for dealing with semi-volatile emission with regard to PM2.5.
- => guidance for UN-ECE, EU

The main questions:

- **For which source categories are condensable organics important?**
- **How much condensables are produced from different:**
  - **combustion technologies?**
  - **measurement techniques?**
- **What is included in EMEP and other emission inventories?**
- **Can we specify the volatility distribution of condensables from major sources?**
- **Can we recommend a practical approach for inclusion (or exclusion) of condensables in (a) inventories, and (b) chemical transport models?**



Report gives overview of field, with focus on RWC and road transport, and provides list of key messages and recommendations.

Available at: www.emep.int/mscw

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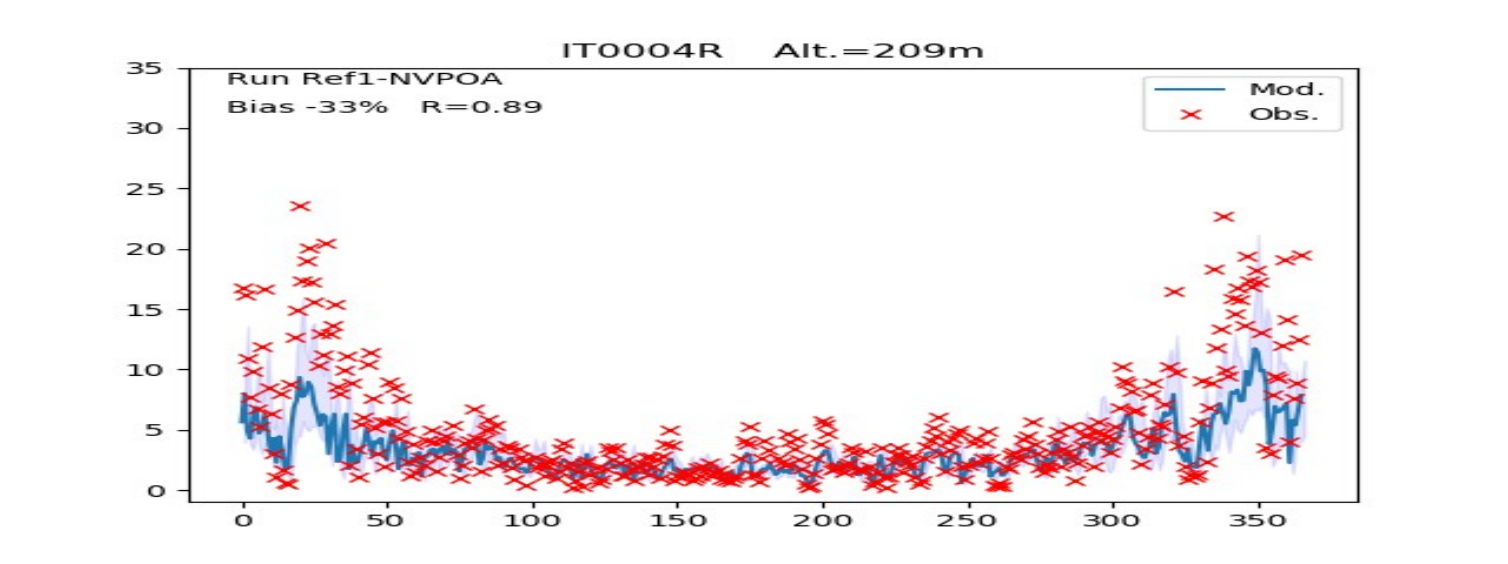
NMR workshop conclusions - short term

- The TNO Ref2 emission inventory is a good first no-regret step for describing condensable emissions from residential wood combustion in emission dispersion modelling
- Ref2 needs to be further documented, and evaluated against national emission and IIASA estimates: focus on RWC in first steps.
- Identify needs for more detailed emission reporting, and communicate clearly to parties. This could for example entail requests for types of wood-stoves, or exhaust standards on road-transport
- Don’t forget IVOC
- Much data and experience is available from the US EPA, and work towards consideration of this can begin now.

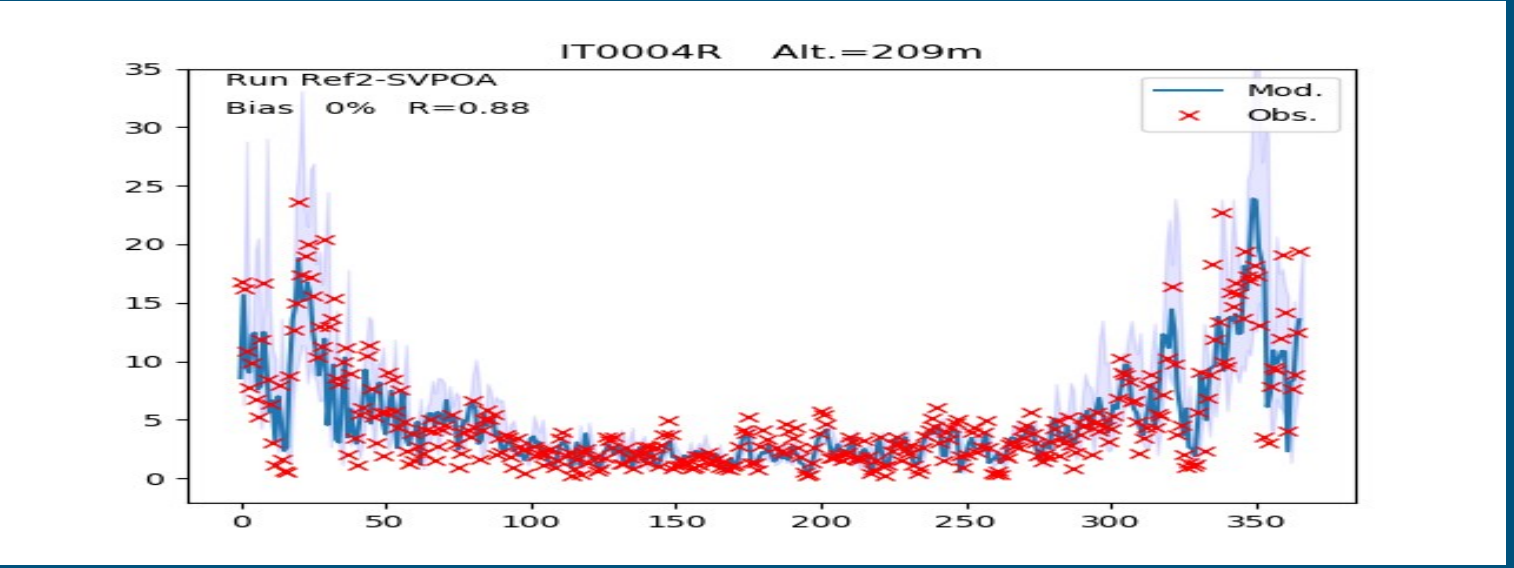
Generally - prepare for more detailed emission reporting requirements - nationally and in Guidebook.

Modelling of condensables, Italy (IT04)

Ref1-NVPOA

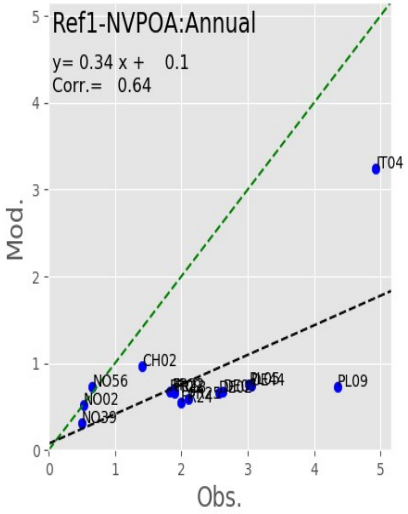


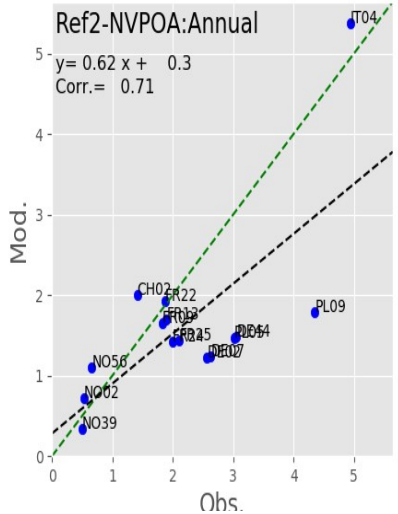
Ref2-SVPOA

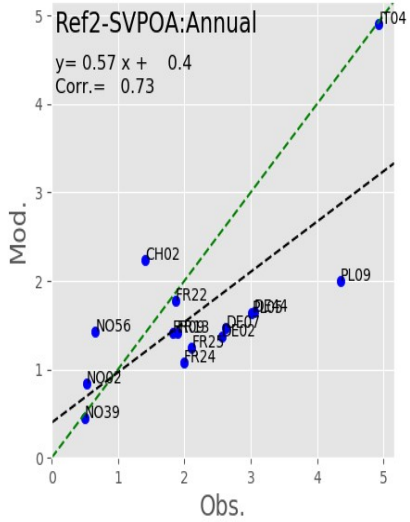


Modelling of condensables, cont.

Modelled vs. Obs- OC (ug/m3) (early results)





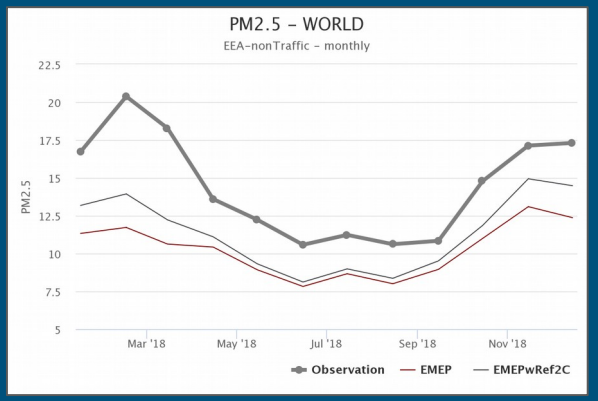


Early modelling with:

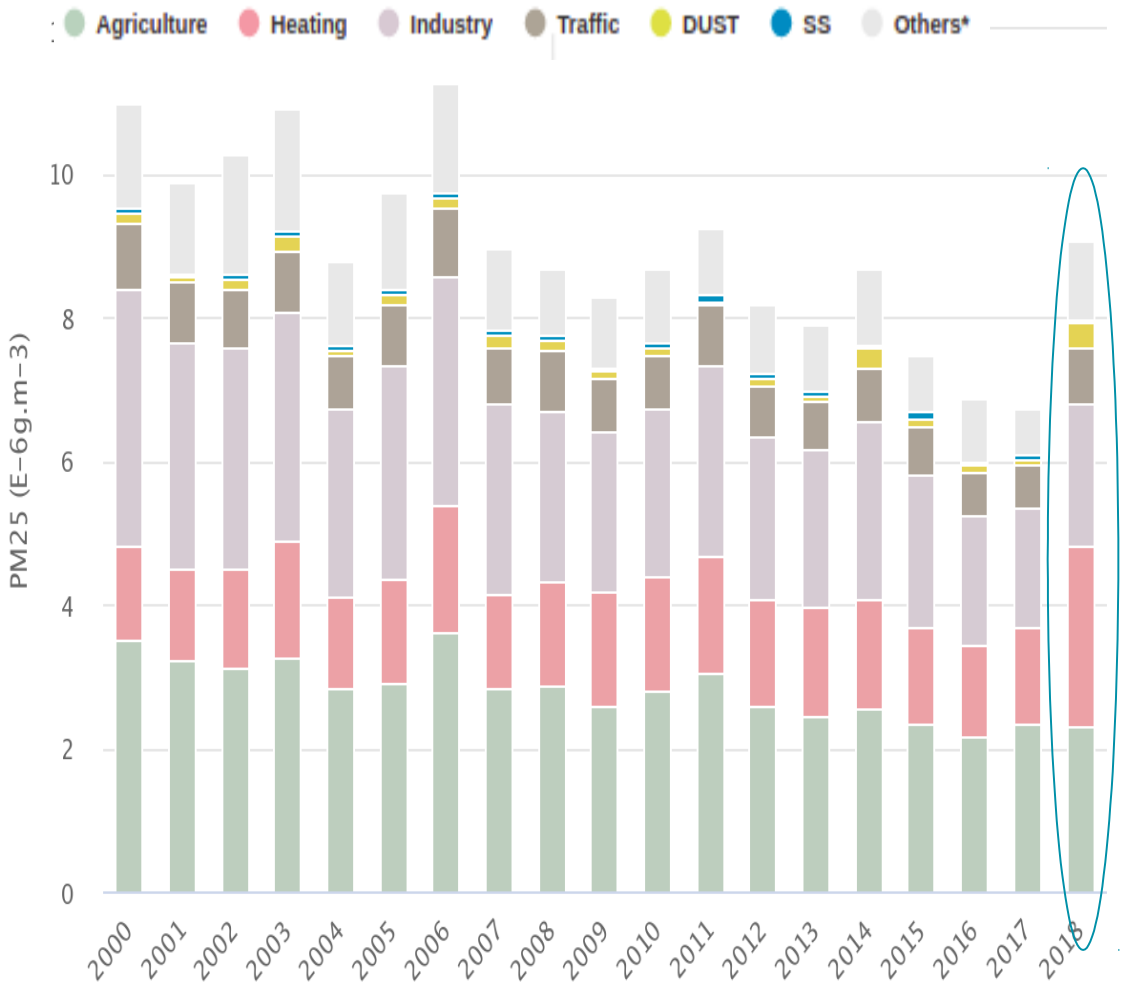
Ref1 (~official) and
Ref2 (TNO estimate)

Model runs treated POA as either non-volatile or (more realistic) semi-volatile.

Most recent calcs, $PM_{2.5}$:



‘Condensables’ impact the relative importance of different emission sectors



Trend 2000-2018:
2018 calculated ‘with condensables’, 2000-2017 without.

Modelled contributions from different sectors to $PM_{2.5}$, Poland. Increased importance of residential heating when including condensable organics.

EMEP: handling the condensable component in the gridded data-set in 2021

- TNO provided a list with Parties where the IEFs (implied emission factors, based on emissions and activity data reported by Parties) suggest that the condensable component was included in PM emissions to CEIP
- CEIP checked for those Parties in the IIRs if the Party confirmed that the condensable component was included in the PM emissions
- If the Party did not provide information or the information was unclear CEIP contacted those Parties beginning of May to ask for confirmation that the condensable component was included in the dataset
- If the Party confirmed that the condensable component was included in emission estimates for the residential combustion emissions the **data reported by Parties was used, otherwise TNO Ref2.1 emissions were used.**
- Aim to use as much data reported by Parties as possible and at the same time ensure a consistent dataset for the EMEP models
- **Reported: 26 Parties Ref 2.1: 17 Parties Gap-filled: 5 Parties**

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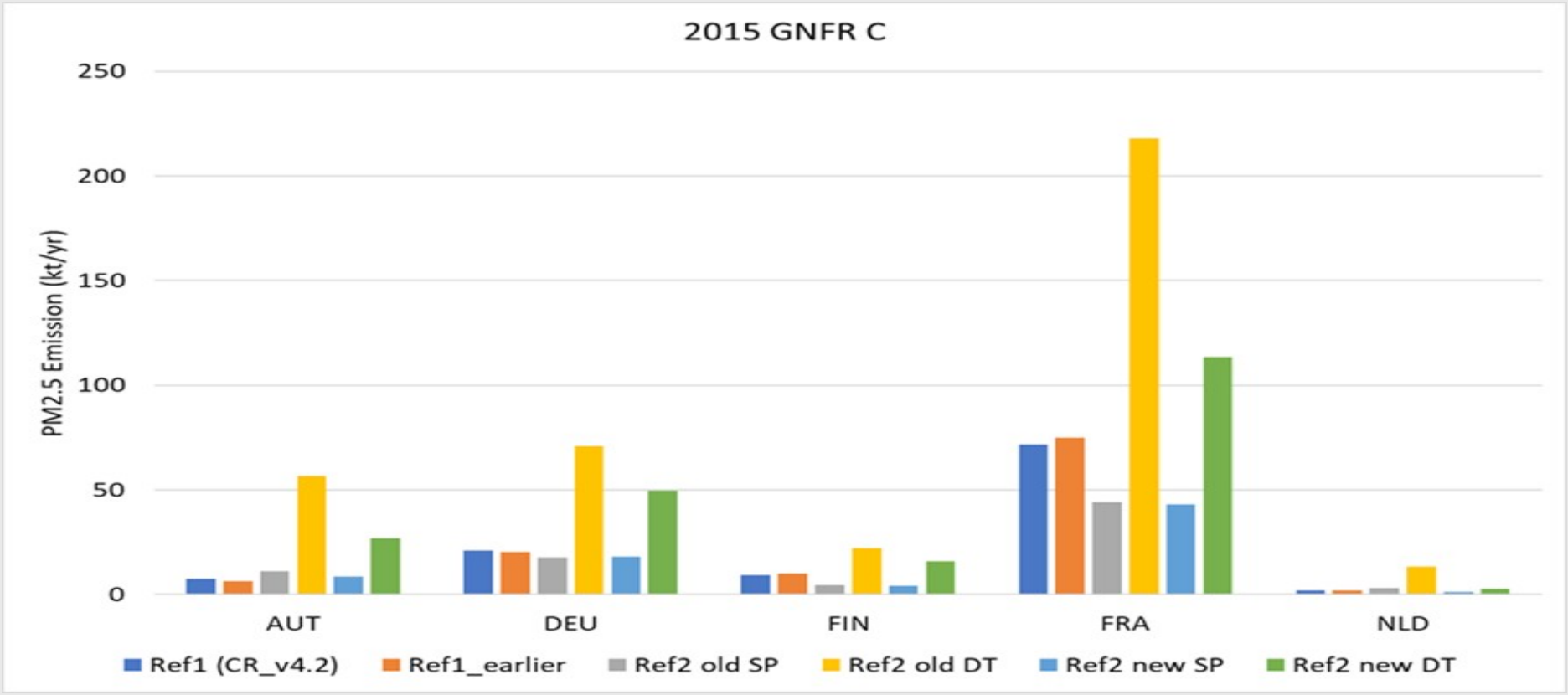
2021 update: EMEPwREF2.1C emissions



REF2.1 is 2021 update of TNO REF2 emissions, after discussions with various countries and update of activity data.

For 2021 EMEP runs, country emission factors for GNFR C were carefully checked (IER) by CEIP&TNO. If condensables missing, replaced with Ref2.1 (for 17 parties) => EMEPwREF2.1C

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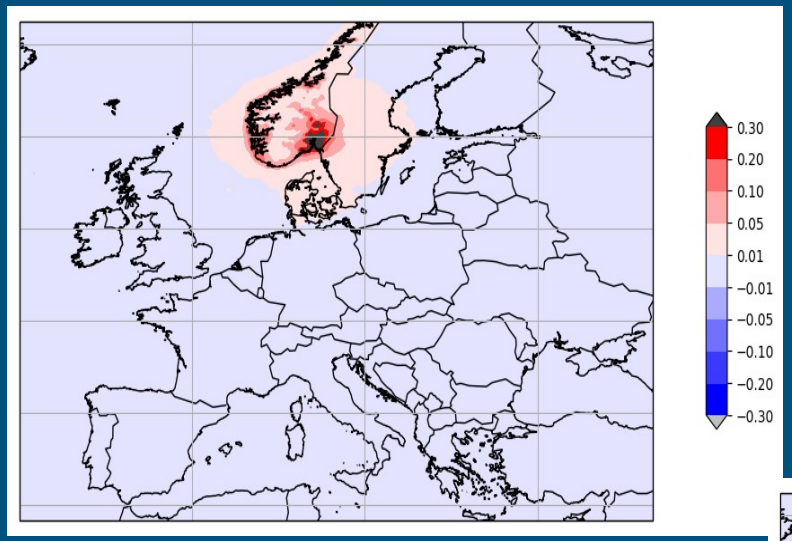
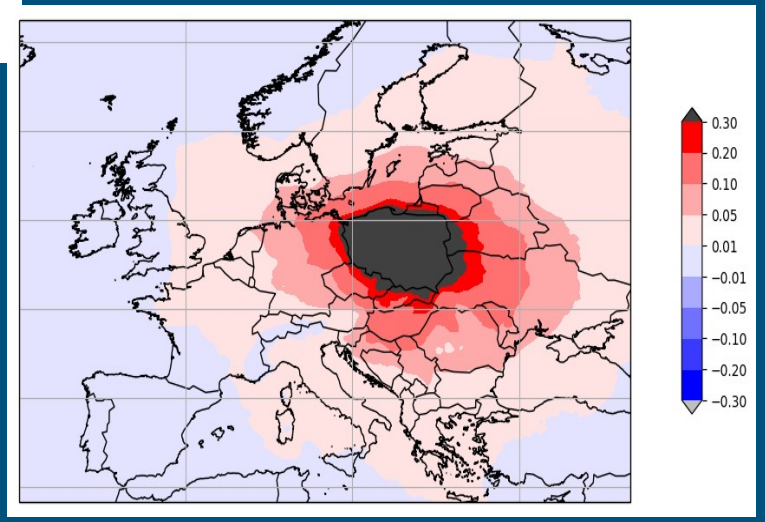
Will be used in source-receptor runs (>1000!) for GP review runs. Starting next week….





EMEP model calculates:

$\Delta PM_{2.5}$ / $\Delta Emis^{pm,i}$

.. for all emitter countries: ***i***

New: NMR-RWC project (2021-2022)

Aims: *Revise historical PM2.5 emissions from residential combustion to consistently include condensable organic compounds (CPMs) and assess the implication for the review of Gothenburg Protocol*

Method: The 2010 'Ref2' TNO emission inventory, which includes CPMs will be extended to cover 2005 - 2018, with:

- consistent small-combustion emissions
- separate solids/CPMs in PM
- fractions of biofuels
- evaluated/improved against data from NordicWelfAir and IIASA

The EMEP model will be used to calculate revised fields of $PM_{2.5}$ across Europe, evaluated against long-term data, and to provide new source-receptor matrices. The implications of these results for the review of the Gothenburg Protocol will be assessed.

Target groups: CLRTAP (incl. TFIAM, TFEIP, TFMM, EMEP), EU/EEA, and CAMS.

NMR-RWC project...

- Questions:
  - Do we have good data on changes in appliances (where from, which years)
  - Does meteorology play a big role? How? (degree days?)
  - Relation of TNO emissions to reported GNFR C?

- Other Data:
  - NordicWelfAir, 1990–2014
  - IIASA have data on installations: boilers/stoves/fireplaces/etc
  - NILU have levoglucosan from 2008-- (trend ca. 3-4%/yr), and BC/OC from 2001

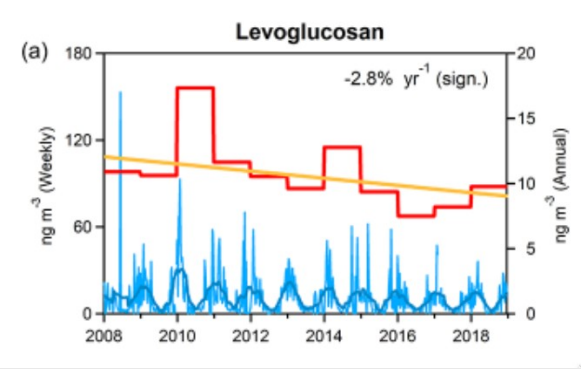


Fig: Yttri et al, ACP, 2021 (Data for Birkenes)

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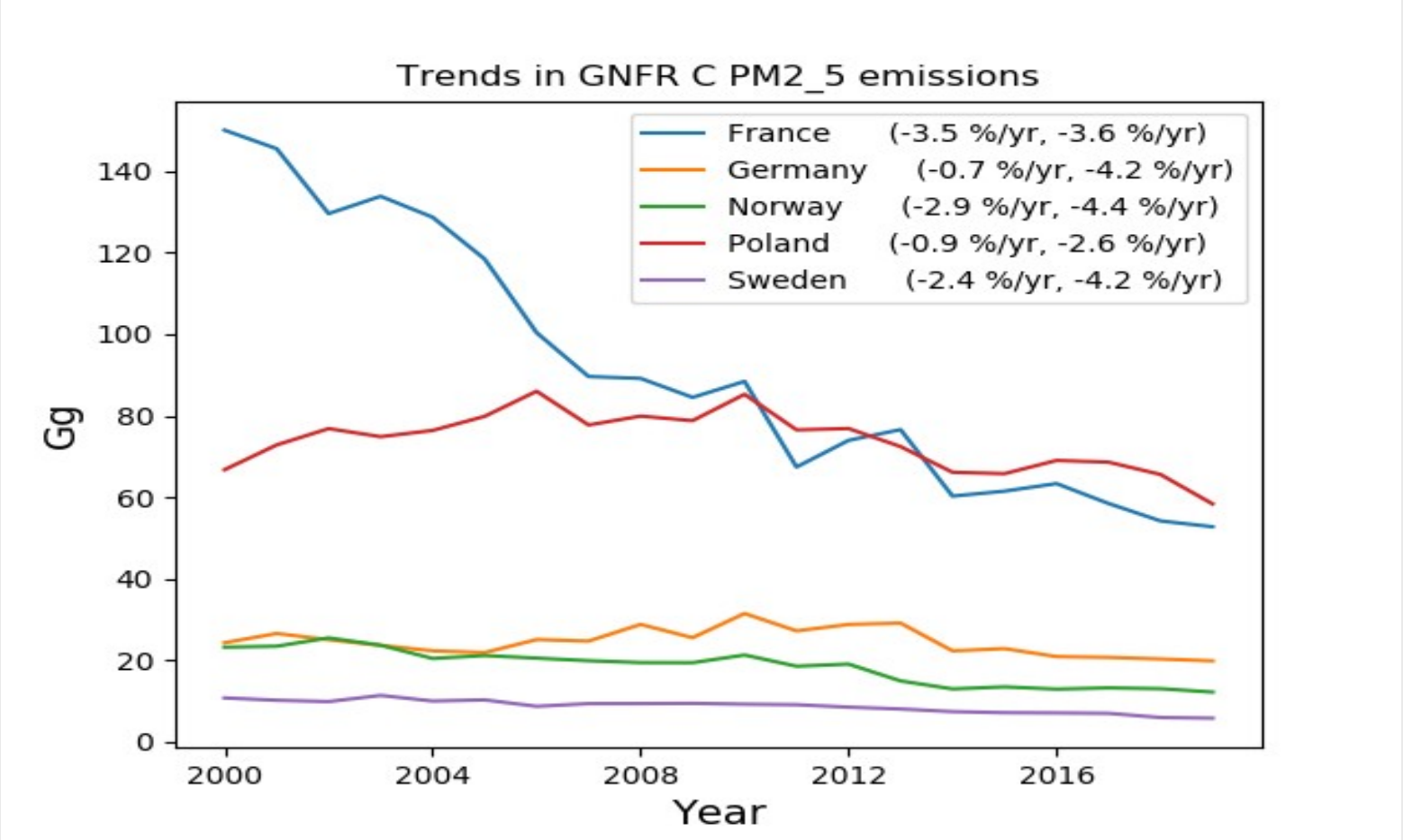
$PM_{2.5}$ GNFR C emissions – selected trends in reported emissions – can we explain/confirm these?

- From EMEP Status Report 1/2021.



Final comments

- Much of post-workshop activity has focused on RWC emissions and `Ref2' for this obvious priority source.
- For a significant number of Parties, the PM emissions from RWC used in the latest EMEP assessment were from TNO Ref2.1 rather than based on their national emission inventory submissions
  - Parties need to be aware of the implications (e.g. changes in source apportionment, impact on emission reduction commitments)
- So far, road transport emissions have escaped this careful scrutiny within EMEP but there are areas for concern (real world emissions, 2-wheelers, etc) – can we quantify?
- The issues are COMPLEX! Much work needed within EMEP/TFEIP/TFTEI/TFMM …. and Guidebook, also with volatility assumptions and much else….
- An ad-hoc group has been set up under EMEP to continue the process (chair Laurence Rouil) and coordination among Task Forces. First meeting (ca. 30 invitees) will be on 5th November. To be continued…..

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Acknowledgements

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And also:

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- Participants - also for flexibility and helpful responses to corona-complications!

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Revising historical PM2.5 emissions from RWC to consistently include condensable organics and assess the implications for the Gothenburg Protocol

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08.01.2015